

What is claimed is:

1. An apparatus for online signature verification analyzing a reference signature database (DB) of a specific user, the apparatus comprising:
 - a signature data input unit for digitalizing a locus of a user signature and reading the digitized locus as a sequence of points sampled at regular time intervals;
 - a first pattern transform unit for performing a speed equalization on the signature sequence read by the signature data input unit and generating a first transformed pattern sequence;
 - a second pattern transform unit for performing a velocity transform on the signature sequence read by the signature data input unit and generating a second transformed pattern sequence;
 - a feature extraction unit for extracting three feature vectors from the signature sequence read by the signature data input unit, the first pattern sequence transformed by the first pattern transform unit and the second pattern sequence transformed by the second pattern transform unit, respectively, to thereby generate the three feature vectors having different information;
 - a difference vector estimation unit for generating a difference vector between the feature vector of the specific user's reference signature read from the reference DB and the feature vector extracted by the feature extraction unit; and
 - a determination unit for determining whether an input signature and the reference signature are signed by a single person, based on the difference vector generated from the difference vector estimation unit.
2. The apparatus of claim 1, wherein the first pattern transform unit transforms the signature sequence read by the signature data input unit and generates the first

transformed pattern sequence, the transform being performed by using a following equation:

(Equation)

$$\begin{aligned} s_i &= p_i & i=1,2 \\ s_i &= s_{i-1} + (p_i - p_{i-1}) & i=N-1, N \\ s_i &= s_{i-1} + v\Delta t \cdot \theta & \text{otherwise} \end{aligned}$$

wherein p_i , s_i , v , Δt , and θ represent a point on an input signature pattern locus, an element of a transformed two-dimensional vector list, a velocity, a time interval between sample points, and a unit vector in the direction of θ , i.e., in the locus at the point p_i , respectively.

3. The apparatus of claim 1, wherein the second pattern transform unit transforms the signature sequence read by the signature data input unit and generates the second transformed pattern sequence, the transform being performed by using a following equation:

(Equation)

$$\begin{aligned} v_i &= v_3 & i=1,2 \\ v_i &= v_{N-2} & i=N-1, N \\ v_i &= (v_{xi}, v_{yi}) & \text{otherwise} \end{aligned}$$

wherein the v_i is an element of the transformed two-dimensional vector list, and v_{xi} and v_{yi} are first horizontal and vertical derivatives at the point p_i on the input signature pattern locus.

4. The apparatus of claim 1, wherein the speed equalization is a technique for recomposing a signature pattern based on an inverse proportional relation between a signature speed and a length of the pattern, and the velocity transform is a technique for transforming a spatial pattern into a velocity domain.

5. A method for online signature verification analyzing a

reference signature DB of a specific user, the method comprising the steps of:

5 (a) digitalizing a locus of a user signature and reading the digitized locus as a sequence of points sampled at regular time intervals;

(b) performing a speed equalization on the signature sequence read in the step (a) to generate a first transformed pattern sequence;

10 (c) performing a velocity transform on the signature sequence read in the step (a) to generate a second transformed pattern sequence;

(d) extracting three characteristics vectors from the signature sequence read in the step (a), the first pattern sequence transformed in the step (b) and the second pattern sequence transformed in the step (c), respectively, to
15 thereby generate three characteristics vectors having different information;

(e) generating a difference vector between the characteristics vector of the specific user's reference signature read from the reference signature DB and the characteristics vector extracted in the step (d); and
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(f) determining whether an input signature and the reference signature are signed by a single person, based on the difference vector generated in the step (e).
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